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*Published in:*  
Appetite

*Publication date:*  
2009

[Link to publication in Tilburg University Research Portal](#)

*Citation for published version (APA):*

Ouwens, M. A., van Strien, T., & van Leeuwe, J. F. J. (2009). Possible pathways between depression, emotional and external eating. A structural equation model. *Appetite*, 53(2), 245-248.

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Short communication

## Possible pathways between depression, emotional and external eating. A structural equation model

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### ARTICLE INFO

#### Article history:

Received 5 January 2009

Received in revised form 26 May 2009

Accepted 1 June 2009

#### Keywords:

Emotional eating

External eating

Depression

Alexithymia

Impulsivity

### ABSTRACT

Emotional and external eating appear to co-occur and both have been shown to correlate to neuroticism, especially depression. However, there is evidence suggesting that emotional and external eating are independent constructs. In this study we revisited the relation between depression, emotional, and external eating. Using structural equation modelling, we examined whether depression, emotional and external eating are directly related and also indirectly related through the intervening concepts alexithymia and impulsivity. Participants were 549 females concerned about their weight. They filled out instruments on emotional and external eating, depression, alexithymia, and impulse regulation. The relational structure between the model variables was explored for one half of the participants and this solution was checked using the other half. Our data showed a moderate relationship between emotional and external eating. Depression was positively and directly associated with emotional eating, but not with external eating. In addition, depression was indirectly related to emotional eating through both alexithymia and impulsivity. A significant relation was found between impulsivity and external eating. Results suggest potential mediating pathways between depression and emotional eating, while no relation appeared to exist between depression and external eating. Emotional and external eating would appear to be different constructs.

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### Introduction

Emotional and external eating appear to co-occur. Thus, correlations of .50 between the emotional and external eating scales of the Dutch Eating Behaviour Questionnaire have been reported (Van Strien, 2002a). In a sample of university students, lower levels of emotional and external eating were related to the same combination of personality traits, i.e. lower levels of neuroticism (including depression) and higher levels of conscientiousness (Heaven, Mulligan, Merrilees, Woods, & Fairouz, 2001). However, there is accumulating evidence that emotional and external eating may refer to independent constructs and that the mechanism that underlies emotional eating might differ from the mechanism that underlies external eating. Thus, only emotional eating, and not external eating, seemed to be the pre-eminent moderator variable of the relationship between daily hassles and snacking (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008). Further, only emotional eating appeared to be related to emotional and relational symptoms, like anxiety, depression, suicidal

ideation and behaviour, and problems in intimate relationships and sexuality (Van Strien, Schippers, & Cox, 1995). Moreover, emotional eating and not external eating, were related to the hypo-functioning of dopamine-related reward systems located in the dorsal striatum of the brain (Volkow et al., 2003). Finally, emotional eating may be more resistant to change compared to external eating (Van Strien & van de Laar, 2008). For example, 4 years after a diet intervention scores on emotional eating had hardly changed in both the male and the female patients with diabetes type II. In contrast, scores on external eating had declined significantly in the female patients and additionally scores on external eating were also associated with a diminished intake of both energy and fat.

In the present study we further investigate the possibility that emotional and external eating refer to different constructs, by revisiting the relation between depression, emotional and external eating that was suggested in the study by Heaven et al. (2001). Employing structural equation modelling we investigated the fit of the model described in Fig. 1.

Affect regulation theories assume a relation between depression and emotional eating. People eat more when they feel depressed, which might be an attempt to regulate these negative feelings. Depression may also be directly related to external eating.

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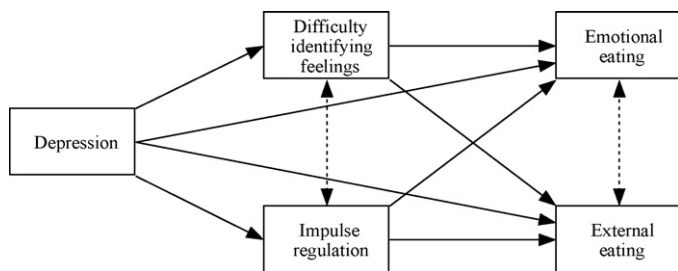


Fig. 1. Initial model.

According to the escape theory of [Heatherton and Baumeister \(1991\)](#), some individuals may narrow their level of attention to the current and immediate stimulus environment (accessible food cues such as snacks), in order to shift attention away from negative affect, like depression. Hence, a positive relation between depression and external eating is expected, even when controlling for emotional eating, because not all people are conscious of their emotional eating patterns ([Van Strien & Ouwens, 2007](#)).

Alexithymia and impulsivity might be the factors that constitute the possible indirect pathways in the relation between depression, emotional, and external eating. Depression and alexithymia, in particular the alexithymic construct 'difficulty identifying feelings', are highly associated ([Parker, Bagby, & Taylor, 1991](#)). Moreover, psychological and biological mechanisms have been proposed to explain why alexithymia may play an important part in emotional eating ([Bruch, 1973](#)). Decreased eating is considered the natural biological response to distress ([Schachter, Goldman, & Gordon, 1968](#)). Increased eating may occur in people who, as a result of learning experiences early in life, develop a lack of interoceptive awareness and confuse emotional distress with hunger. Poor interoceptive awareness has close correspondence with alexithymia, particularly the alexithymic aspect 'difficulty identifying feelings' ([Garner, 1991](#)). In a recent experiment, alexithymia moderated the relationship between experimentally induced distress and food intake ([Van Strien & Ouwens, 2007](#)), which supports the relation between alexithymia and emotional eating found in previous survey studies ([Larsen, Van Strien, Eisinga, & Engels, 2006](#); [Van Strien, 2000](#)).

Alexithymia may also mediate the relation between depression and external eating. The eating of external eaters is largely determined by the external food environment and low responsiveness to internal physiological signals, such as gastric motility, has also been suggested as important characteristic of external eaters ([Rodin, 1981](#)). Additionally, as shown in a series of studies by [Slochow \(1983\)](#), stress may enhance the reaction to food cues, so that stress may act as a stimulus to eat among those high in external eating (see also [O'Connor et al., 2008](#)).

Following escape theory, depression may also be related indirectly to both emotional and external eating, through the intervening construct 'impulse regulation'. Specifically, in addition to excessive intake of food, excessive intake of alcohol or drugs, or other impulsive and destructive behaviours could serve to escape/block awareness of depressed feelings, theoretically explaining the link between depression, impulsivity, and emotional eating ([Heatherton & Baumeister, 1991](#)). Both problems in impulse regulation and emotional eating have been related to a shortage of brain dopamine ([Blum et al., 2000](#); [Dawe & Loxton, 2004](#); [Volkow et al., 2003](#)).

Impulsivity may also be linked to the tendency toward external eating. Individuals prone to external eating have been characterised as being 'stimulus bound' ([Schachter, 1971, p. 127](#)) and poor impulse regulation in non-food areas was found to be associated with external eating ([Van Strien et al., 1995](#)).

The aim of the present study was to examine whether depression is directly associated with emotional and external eating, and to examine possible indirect pathways between depression and overeating tendencies through the intervening concepts of 'impulsivity' and 'difficulty identifying feelings'. In a questionnaire study, we tested these relationships in a female population because significant associations between depression and obesity were found among women and not men ([Friedman & Brownell, 1995](#)). A weight concerned, predominantly overweight female population will be subdivided into two groups balanced for important characteristics such as body mass, age, and education. One group will be used to explore the relational structure employing structural equation modelling and the other group will be used to check the solution.

## Method

### Participants and measures

The sample was recruited through a) advertisements in local newspapers, (b) an obesity journal and c) by intake screening in an obesity clinic. Complete information was obtained on 549 females.

Emotional and external eating were measured with the Dutch Eating Behaviour Questionnaire (DEBQ; [Van Strien, 2002a](#)). Cronbach's alpha's were, respectively, .94 and .84.

'Difficulty identifying feelings' was measured with the seven-item subscale of the Toronto Alexithymia Scale-20, the TAS-20 ([Bagby, Parker, & Taylor, 1994](#); Dutch translation: [Kooiman, Spinhoven, & Trijsburg, 2002](#)). Cronbach's alpha's was .89.

Impulsivity was measured with a scale of the Eating Disorder Inventory-2 (EDI-2, [Garner, 1991](#); Dutch version: [Van Strien, 2002b](#)). We utilized untransformed responses, as scale transformation was found to damage the validity of the EDI among non-clinical populations ([Van Strien & Ouwens, 2003a](#)). Cronbach's alpha was .76.

Depression was measured with the Dutch version of the Hopkins Symptom Checklist-90 (SCL-90) ([Derogatis, 1977](#); [Arrindell & Ettema, 1991](#)). To avoid criterion confounding one item about weight loss was excluded. Cronbach's alpha was .93.

### Statistical analyses

All variables were inspected for skewness and kurtosis and no problems were observed. Next, descriptive analyses were conducted to gather information about the means, standard deviations, and inter-correlations of the model variables. In this study, direct pathways between depression and eating tendencies, and indirect pathways through impulse regulation and difficulty identifying feelings, were tested in one model (see [Fig. 1](#)).

In order to study particular intermediate relations within this model, four structural equation analyses were executed with three variables each. In these analyses, we examined whether difficulty identifying feelings and impulse regulation mediated between depression on the one hand and emotional or external eating on the other. The results of these analyses were then used to verify the existence of the relations within the model of [Fig. 1](#) and to build the final model. Cross-validation of the final model was performed by analyzing two balanced subgroups. Balancing was done with respect to manner of recruitment (local newspaper, obesity journal, or obesity clinic), education, body mass and age. Next, the assignment of cases to the groups was performed randomly. Two groups of 274 and 275 cases, respectively, were generated this way. Structural equation analysis was performed using AMOS 5.0 ([Arbuckle & Wothke, 1999](#)). Fit of the models was judged by using the Chi-square test, the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), the normed fit index (NFI) and the root

mean square error of approximation (RMSEA). Following Hu and Bentler (1999) and Jaccard and Wan (1996), a model fits reasonably well if the Chi-square value does not exceed a limited multiple (i.e. 3) of its degrees of freedom, GFI, AGFI and NFI are large (greater than .90) and RMSEA is small (less than .08). The Chi-square difference test is used to check whether the model does differ for the two subsamples.

## Results

The participants age was between 18 and 60 years and BMI (body mass index, weight/height  $\times$  height (kg/m<sup>2</sup>)) was between 18 and 60. The mean BMI was 33.5 (SD = 8.5) and the mean age was 41.3 (SD = 10.22). Some 8.9% had only primary education, 47.2% had secondary education, and 43.9% were tertiary educated. The two subgroups balanced by way of recruitment (local newspaper, obesity journal or obesity clinic), education, body mass and age: the first group and the second group, respectively, education: 2.3 (SD = .3) and 2.4 (SD = .6); BMI: 33.5 (SD = 8.4) and 33.5 (SD = 8.6); age: 40.9 (SD = 10.5) and 41.7 (SD = 9.9).

Table 1 shows the means, standard deviations, and Pearson correlation coefficients of the model variables for the total sample. Emotional and external eating were moderately interrelated and 'difficulty identifying feelings', impulsivity, and depression were all strongly interrelated. Of special interest is the finding that correlations of 'difficulty identifying feelings', impulsivity, and depression were all higher with emotional eating (.34,  $p < .01$ ; .36,  $p < .01$ ; .38,  $p < .01$ ) than with external eating (.10,  $p < .05$ ; .17,  $p < .01$ ; .12,  $p < .01$ , respectively). When we consider emotional eating to be the dependent variable we may conclude from supplementary data that both variables 'difficulty identifying feelings' and 'impulsivity' are intermediate variables between the depression and emotional eating. Both the direct regressions as well as the regressions in the indirect paths contribute significantly, for 'difficulty identifying feelings' and impulsivity.

In contrast, 'difficulty identifying feelings' has no significant influence on external eating, nor does depression, as shown in display 3 of supplementary data. This latter conclusion is confirmed in display 4, where it is shown that impulsivity does influence external eating. (It is noted that the models of supplementary data are all saturated, so no model testing can be performed. This holds too for the model of Fig. 1 given that all pairs of variables are related.)

Returning to the complete model, we conclude that there are no direct relations between 'difficulty identifying feelings' and external eating and between depression and external eating. This is established by running the model shown in Fig. 2, where these two insignificant direct relations are removed.

This model fits the data very well: Chi-square = .054 (df = 2,  $p = .973$ ), GFI = 1.000, AFGI = 1.000, NFI = 1.000, RMSEA = .000. Additional validation is given by running the model of Fig. 2, for the two halves of the sample. Adequate fit testing in this situation

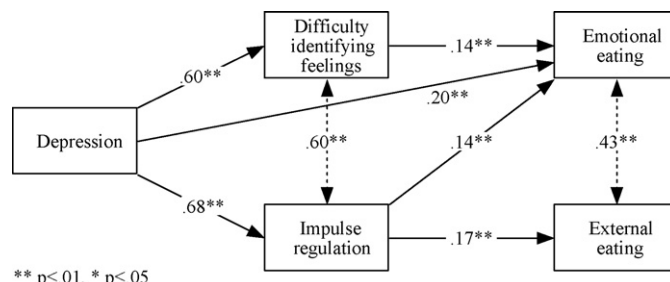
**Table 1**

Pearson correlations and means and standard deviations of emotional eating, external eating, difficulty identifying feelings, impulsivity and depression.

	1-EmE	2-ExE	3-DIF	4-Imp	5-Dep
1. Emotional eating					
2. External eating	.43**				
3. Difficulty identifying feelings	.34**	.10*			
4. Impulsivity	.36**	.17**	.60**		
5. Depression	.38**	.12**	.60**	.68**	
Mean	3.09	3.00	2.37	25.49	1.95
Standard deviation	.84	.61	.94	6.36	.86

\*  $p < .05$ .

\*\*  $p < .01$ .



\*\*  $p < .01$ , \*  $p < .05$

**Fig. 2.** Final model, total group,  $n = 549$ .

is performed by model comparison between two multiple-groups models. In the first analysis, parameters are allowed to be free for the two groups. The fit indicators are Chi-square = 3.915 (df = 4,  $p = .418$ ), GFI = .997, AGFI = .979, NFI = .995, RMSEA = .000 for this model, indicating that in both groups the model of Fig. 2 is established. In the second analysis, parameters are assumed to be equal over both groups. The fit indicators are Chi-square = 7.558 (df = 12,  $p = .419$ ), GFI = .994, AGFI = .986, NFI = .991, RMSEA = .000 for this model. The Chi-square difference test yields Chi-square = 3.643 (df = 8,  $p = .888$ ), which means that the hypothesis that the two groups differ cannot be rejected.

## Discussion

The present study examined the relationship between depression and various overeating tendencies. Depression was positively and directly associated with emotional eating but not with external eating. In addition, depression appeared to be indirectly related to emotional eating through 'difficulty identifying feelings' and impulsivity. Further, a significant relationship was found between impulsivity and external eating. These findings support the view that different mechanisms lie behind emotional and external eating and that these overeating tendencies are thus different constructs. Emotional eating, in contrast to external eating, seems to come down to affect regulation problems, in this case depression regulations problems.

The direct relationship between negative affect and emotional eating has been proposed by affect regulation/escape theories, in which emotional eating is thought to reduce awareness of distress through blocking or dissociation (Hallings-Pott, Waller, Watson, & Scragg, 2006) or follows a reduction in awareness of distress (Heatherton & Baumeister, 1991). The present outcome is consistent with previous work on stress and eating that showed significant associations between negative affect (or stress) and increased eating in normal weight and obese emotional eaters (e.g. O'Connor et al., 2008; Oliver, Wardle, & Gibson, 2000; Van Strien & Ouwens, 2003b).

Depression was not directly related to external eating, but we did find a significant relationship between impulsivity and external eating. The fact that external eating was neither related to 'difficulty identifying feelings' nor to depression and only showed a relationship with impulsivity, suggests that this type of overeating is not associated with alexithymia, affect regulation, or escape tendencies. Volkow et al. (2003) have postulated that external eating may be related to factors regulating the perceptual properties of food, for example, increased activity in the somatosensory cortex for the lips and tongue that is not linked to brain dopamine activity. Alternatively, external eaters may suffer from an over-conditioning of "Cephalic phase responses" (Powley, 1977), anticipatory features of the consummatory response such as hyperinsulaemia and increased salivation, which prepare the organism to eat and digest. These contentions were supported in an experimental study by Nederkoorn and Jansen (2002), in which



physiological reactivity to food cues was associated with subjective experiences of craving, in their turn associated with increases in food intake.

Sensitivity to external food cues and impulsivity have both received renewed interest in explaining inter-individual differences in susceptibility to weight gain in our obesogenic environment (Wansink, Payne, & Chandon, 2007). The association of impulsivity with external eating in the present study is in correspondence with earlier findings (e.g. Van Strien, 2000; Van Strien, Engels, Van Leeuwe, & Snoek, 2005), and suggest that it may be of interest to investigate external eating along with impulsivity. For example, it may be worthwhile to consider external eating as a possible intervening variable in the pathway between impulsivity and increased intake of food or overweight.

The current research has also advanced our understanding of possible intervening constructs in the relationship between depression and emotional eating. The finding that 'difficulty identifying feelings' was an intervening construct in this relationship is consistent with Bruch's original theory that stress-induced emotional eating may occur in people who, as a result of early learning experiences, have difficulty in recognising emotional states and visceral sensations related to hunger and satiety (Bruch, 1973). Previously, we have shown significant associations between 'difficulty identifying feelings' and emotional eating (Larsen et al., 2006; Ouwens, van Strien, van Leeuwe, & van der Staak, 2009; Van Strien, 2000; Van Strien et al., 2005). This possible association has recently been supported by results from an experimental study, showing that stress-induced eating was most apparent among individuals who had difficulties identifying their feelings (Van Strien & Ouwens, 2007). Our data are consistent with the previous established relation between 'difficulty identifying feelings' and emotional eating, and indicate that 'difficulty identifying feelings' is a partial mediator between depression and emotional eating.

Limitations of the study were the cross-sectional design and that one can only reject, not confirm, models employing Structural Equation Modelling. A strength was that the tested models all had a strong theoretical basis and that our internal cross-validation design gives further credence to our findings.

In conclusion, the present study showed that depression is directly as well as indirectly associated with emotional eating, but not external eating. Emotional eating may be further examined as a potential mediating mechanism between depression and obesity. The significant relation between external eating and impulsivity may warrant the simultaneous examination of impulsivity, external eating, and obesity.

## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.appet.2009.06.001](https://doi.org/10.1016/j.appet.2009.06.001).

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